U. S. DEPARTMENT OF COMMERCE

BUREAU OF FISHERIES

Fishery Circular No. 23 Issued July 1936

DECLINE IN HADDOCK ABUNDANCE ON GEORGES BANK AND A PRACTICAL REMEDY[1]

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INTRODUCTION

New England has no broad grazing lands like the far-flung prairies of the West, on which great herds of cattle can be raised and fattened for her markets; but close at hand she has another and, in some ways, similar natural resource that was in use long before the western prairies ever saw a steer or cowboy. Imagine a great grazing land nearly equal to the combined areas of Massachusetts, Connecticut, and New Hampshire. Sink this whole area into the sea until the low hills are barely covered by the tossing waves and you have Georges Bank,[2] a great fishing ground stretching eastward from Cape Cod. In past years this bank has been the greatest and most fertile fishing area to be found on the coast of the United States. Farther to the eastward lie the Nova Scotian Banks, and still farther east is the Grand Bank of Newfoundland. Instead of herds of cattle, the broad stretches of the fishing grounds support great shoals of fish of many kinds which roam about the banks, each searching for its most favored food and climate.

For hundreds of years New England's fishermen have reaped from the fishing banks a great harvest of food which has formed a valued adjunct to the crops wrung from her stony acres. In the early days this catch was small; but, with the passing years, the fishery grew until in 1924 New England fishing boats alone caught

[1] Fishery Circular No. 23. Approved for publication, Feb. 24, 1936.

[2] In this article the term "Georges Bank" refers to the region extending from Nantucket Shoals to the deep channel between Georges and Browns Banks. It includes the banks usually referred to as Georges, South Channel, and Nantucket Shoals.

190,000,000 pounds of marketable fish. During all these years there seemed to be no limit to the supply; if one kind of fish grew scarce, there always was another to take its place, and the only effective limit to the fishermen's catch was the market and price that could be obtained. About 1924 the packaging of fresh and frozen haddock fillets was developed, and there followed immediately a tremendous

FIGURE 1.—Unloading groundfish at the Boston Fish Pier. In 1929 about 187,000,000 pounds of large and scrod haddock were landed at this pier.

increase in the demand for this easily handled product. The fisherman always had found haddock in great numbers on Georges Bank; but, as he primarily was seeking cod, haddock were more or less of a nuisance. When the filleting business created an expanding market for haddock, it started the race for more and bigger haddock catches. In the 5 years between 1924 and 1929, the annual New England haddock catch jumped from 93,500,000 pounds to nearly 256,000,000 pounds.

Two hundred and fifty-six million pounds of haddock is a lot of fish. It is difficult to realize how much it is without actually seeing it. It is enough to provide every man, woman, and child in New England with a haddock dinner on every Friday in the year, not to mention the heads and tails left over for the family dog and cat. If these haddock could be strung end to end, like elongated beads, we should have a necklace with which we could swing nine strands across the Atlantic from New England to Old England. Or perhaps they could be lined up in single column, nose to tail, and started swimming from the fishing banks up past Highland Light and Cape Cod at a 3-knot speed. After this had continued day and night for an entire year, there still would be enough left over to make a string of fish extending nearly to the Grand Bank of Newfoundland. Or visualize a steady downpour of haddock falling 450 fish a minute into the fish wharves at Boston, Gloucester, or Portland, from 7 in the morning to 3 in the afternoon, every day in the year, Sundays, Christmas, and New Year's included. If you can visualize this, you should get the point: 256,000,000 pounds of haddock is a lot of fish.

The increase in New England vessel landings during the last decade was due primarily to the growth of the haddock fishery. The haddock catch rose rapidly from a minor part of the catch until in 1929 it completely overshadowed all other kinds of fish. In that year fishing boats landed at Boston, Gloucester, Portland, Groton, and New York 243,000,000 pounds of haddock, compared to 164,000,000 pounds of all other fish (fig. 2).

The year 1929 was the high point in the haddock fishery. Since then the catch has declined; a decline that cannot be blamed entirely on the omnipresent depression. Haddock landings at Boston, Gloucester, and Portland decreased from 187,000,000 pounds in 1929 to 35,000,000 pounds in 1934,[3] while the catch of other species increased from 145,000,000 pounds to 180,000,000 pounds during the same years. It is obvious that we have more than the depression to blame for the decline in the haddock fishery. It is this decline and what it implies that forms the basis of this paper.

THE HADDOCK FISHERY

On the North American coast the main bodies of haddock are found in three general areas. There is, first, the Georges Bank region with which we include South Channel and Nantucket Shoals; second, the Nova Scotian Banks extending in a series from Browns Bank to Quereau; and, third, the Grand Bank of Newfoundland (fig 3).

During past years Georges Bank has furnished a very large share of the haddock caught by New England boats. Haddock have been more abundant there than in any other area, they grow much faster, and appear to be fatter and in better condition than haddock caught on other banks. This bank also is the closest to New England ports, making it possible to land and market the fish in better condition due to the short run from the fishing ground.

[3] 1934 figures for Groton and New York are not yet available.

Until recent years the Nova Scotian Banks played a small part in the New England haddock fishery. Frequently, during a brief period in April, there was considerable fishing on Browns Bank, but during the remainder of the year haddock usually were found in abundance only on the banks to the eastward, such as Sable Island, Quereau, and Middle Ground. As these banks lie 500 to 600 miles from our ports, they were seldom visited by New England

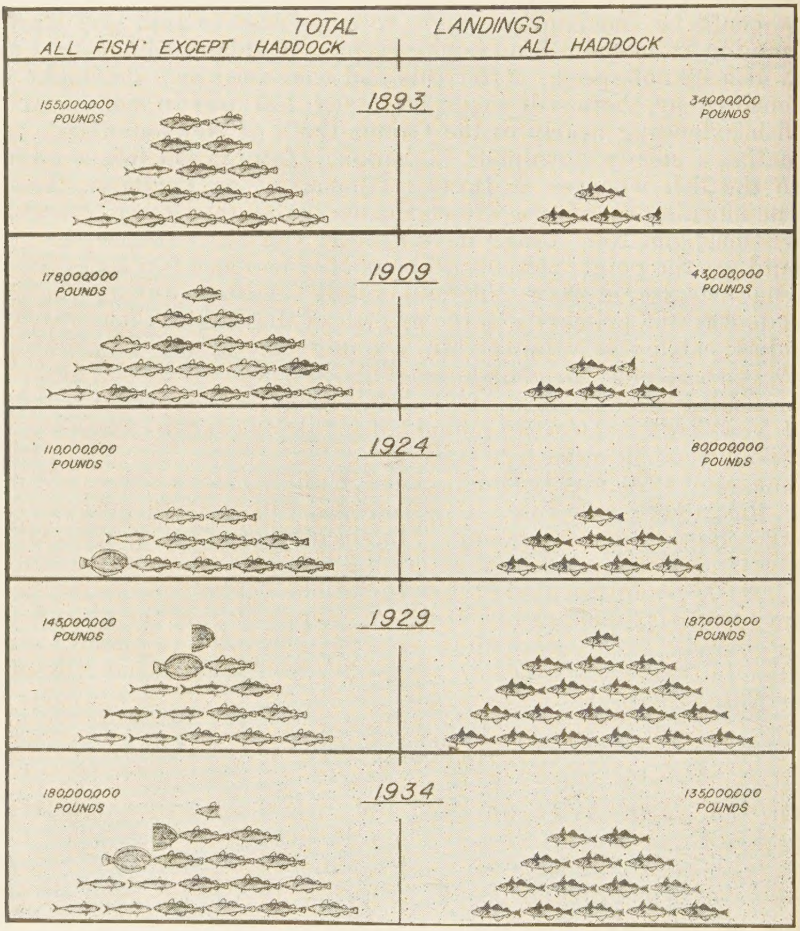

FIGURE 2.—Annual vessel landings at Boston, Gloucester, and Portland for a number of years since 1893 (the first year for which separate records are available). Each fish in the chart represents 10,000,000 pounds of fish landed. Note the great increase in haddock landings in 1929 and the decline in 1934. Note also the 1934 increase in the catch of other species. Landings at Groton and New York are not included in this chart as records for these ports are not available for all of the years shown.

boats until recent years when such trips became necessary owing to the scarcity of fish nearer home. Haddock on these distant banks grow slowly, requiring nearly 5 years to reach commercial size compared to 3 to 3½ years on Georges.

The Grand Bank of Newfoundland offers little promise as a major source of haddock for New England markets. Due to low water

emperatures, haddock are limited to the western parts of the bank nd even there ordinarily are scattered and much less abundant than n Sable Island and Quereau. Their spread to the east and north

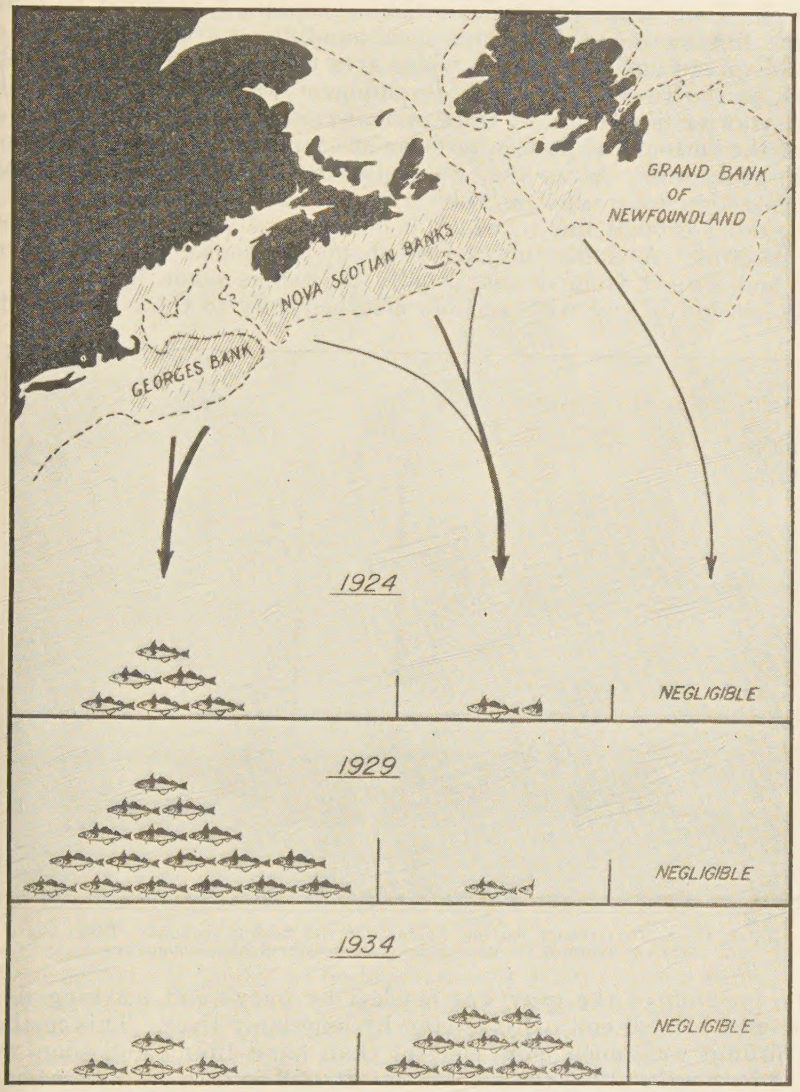

FIGURE 3.—Principal fishing grounds where haddock are found and the annual catch on each. Each fish in the figure represents 10,000,000 pounds of haddock landed. The shaded areas show where haddock are most abundant. Note the great decline between 1929 and 1934 in the catch on Georges and the increase in the catch from Nova Scotian Banks.

limited by the cold arctic water coming down from the Labrador past.

Beyond the Grand Bank no haddock are found until the shores f Iceland are reached. This region already is subject to a heavy shery by the trawlers from Great Britain, Germany, and France.

FISHING METHODS

In the early days of America, haddock as well as cod and ot
fish were caught by hand lines fished from the deck of the fish
vessel. Later some enterprising fishing captain found that he co
catch fish more rapidly if his men hand lined from dories wh
could spread out and cover a wider area than was possible from
deck of the vessel. The next development was line trawling.
line trawler used long set lines or trawl lines which were stretch
over the bottom and held in position at each end with a light anch
The gear, when not in use, was coiled in half-kegs or tubs, he
each section was called a "tub" of gear. Each tub consisted o
long stout ground line to which hooks were attached by short li
or gangins. A single tub carried about 350 hooks. The gear
set and hauled from dories, usually in strings made up of 3 t
tubs set end to end with anchors attached only to the outside en

FIGURE 4.—A line trawler leaving Boston for the fishing grounds. Those boa
are survivors of the once famous Gloucester fishing schooners.

The position of the gear was marked by buoys and marking f
attached to each end of the string by long buoy lines. This met
of fishing was much more efficient than hand lining and soon
used by nearly all of the fishermen. It still is used by many bo
especially in regions where the bottom is very rough (fig. 4).

In 1905 a new type of gear, the otter trawl, was introduced
New England from the European fishery in the North Sea. Es
tially, this gear is a great flattened cone of netting which is drag
over the bottom by the trawling vessel. The outer edges or w
of the net are held extended by otter boards or "doors" rigge
the towing warps like kites so that they plane outward and
the mouth of the net open. These great nets, 80 to 120 feet ac

he mouth, are dragged over the bottom at a speed of 2½ to 3½ nots and sweep up all fish in their paths. On good bottom these ets proved more efficient than line trawls and to a large extent hey have supplanted the older type of gear (fig. 5).

The growth of the otter-trawl fleet closely parallels the growth of he modern haddock fishery. In 1905 the first otter trawlers began ishing out of Boston. In 1915 there were 11 such vessels, and they anded a total of over 17,000,000 pounds of haddock. Trawling was o successful that the number of boats using this gear increased teadily. In 1921 the fleet included 26 large steam trawlers which anded a total of 27,000,000 pounds of haddock, 94 percent of which ame from Georges Bank. All other boats landed about 40,000,000

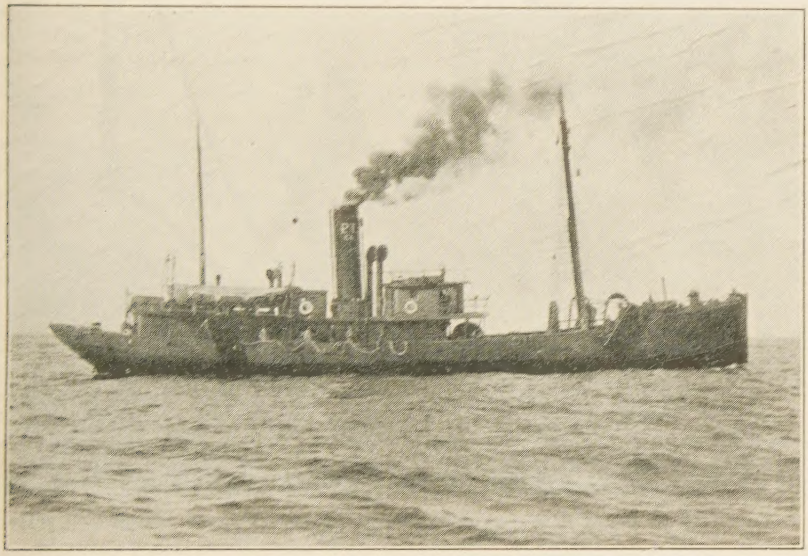

FIGURE 5.—Large otter trawler, *Kingfisher*, on the fishing grounds ready to "shoot" her net for the next haul. Boats of this type commonly are miscalled "beam trawlers." (Photo courtesy W. A. Ellison, Jr.)

ounds of haddock. By 1929 the fleet of large otter trawlers, most f the new ones using Diesel power, had increased to 62. In that ear this group of boats landed at Boston, Gloucester, and Portland, bout 98,000,000 pounds of haddock, mostly from Georges Bank. In ddition, there was a fleet of more than 170 medium and small otter rawlers, commonly called draggers, which landed 58,000,000 pounds f haddock at the same ports. Thus otter trawlers of all sizes nded a total of about 156,000,000 pounds, which was 83 percent of ie total haddock catch of 187,000,000 pounds. All other fish landed these three ports by all fishing boats amounted to only 145,000,000 ounds. (See fig. 2.)

Since the introduction of the otter trawl in 1905 there has been uch controversy over its use and many questionable claims and ccusations have been made on both sides of the argument. However, n unbiased observer can find much to be said in favor of this shing method as well as some things against it. It has proved to be ore efficient than old methods; therefore, it is good to the extent

that it makes haddock available to a wider market at a lower price. Also, trawling can be continued in rough weather when other methods of fishing must cease; therefore, it provides a steadier supply of fresh fish to the markets. Probably these are the most obvious arguments in favor of this gear. On the other hand, the principal charge that has been established against the otter trawl is that it destroys great numbers of undersized fish of all kinds.

When the otter trawl is dragged along the sea bottom, it gathers up everything in its path that is not too firmly attached or sufficiently swift and intelligent to get out of the way. As most fish belong in neither of these exceptions, they are swept up in the trawl.

FIGURE 6.—Deck view on *Exeter*—an otter trawler of the type commonly called "dragger" just before "shooting" the trawl.

The majority of the smallest sizes, i. e., those below one-fourth to one-half pound, gets through the meshes of the net and escapes, but the remainder is held in the cod end until it is hauled up and dumped on the trawler's deck. Nearly all species of ground fish such as haddock, cod, and hake are of no commercial value until they reach a weight of about 1½ pounds. Consequently, the great numbers of baby fish below this size are of no value and are shoveled overboard dead. Many times the trawler's catch includes more baby haddock and cod than fish of marketable size. This destruction of undersized fish is a total waste for these fish are of no value when caught, yet if left on the bank another year or two, they would reach marketable size.

DECLINE OF THE NEW ENGLAND HADDOCK FISHERY

During the early days of the haddock fishery, even as late as 1928, no one lost much sleep worrying about a plentiful supply of fish. The primary problem was the development and maintenance of an

adequate market and price to utilize the catch of the fishing fleet. Haddock were found in such abundance on nearby Georges Bank that it seemed a waste of time to worry about the future. Since good catches could be made on Georges, a trip to the more distant Nova Scotian Banks was a waste of time and fuel.

Since this heyday of the fishery, there has been a dramatic change in conditions. In former years a plentiful supply of fish was available but the market was limited. Now there is a more widespread market but the supply of haddock is limited. The decline in the catch is due largely to the growing scarcity of fish on nearby banks. During the past 5 years (1930–34) the trawlers fishing on Georges Bank have averaged scarcely one-third as much haddock per day as during the previous 5 years. These poor catches have persisted in spite of improvements in fishing gear and in the efficiency of the fleet. They are due to actual scarcity of fish. As a result of this scarcity, Georges Bank, which formerly furnished the bulk of New England's ground fish, now supports a much reduced fishery.

New England haddock landings for the time being have been partially maintained by extending the fishery to distant Sable Island Bank and Quereau. However, this involves a long trip with increased production costs. Furthermore, it is more difficult to get fish back to port in good condition due to the length of time intervening between catching the fish on the banks and landing the fish at the dock.

The shift in the fishery to distant banks has been greatest in the last 2 years. During 1926–30, New England boats fishing out of Boston, Gloucester, and Portland caught an average of 130,000,000 pounds of haddock a year on Georges Bank compared to 13,000,000 a year on the Nova Scotian Banks. During 1934 this fleet (which had increased in numbers since the earlier years) caught but 40,000,000 pounds of haddock on Georges compared to 88,000,000 pounds on the Nova Scotian Banks. (See fig. 3.) The longer trips required to reach the latter banks (round trip averages 300 miles to Georges and 1,000 miles to Sable Island and Quereau) resulted in a large increase in running time. In 1934 alone the trips to the Nova Scotian Banks increased the aggregate running time of the otter-trawl fleet by more than 2,600 days. In other words, if the trawlers had been able to find good fishing on Georges in 1934, the fleet could have spent 2,600 fewer days in running between port and the fishing ground and 2,600 more days in active fishing. A trawler's time is worth something like $250 or more a day; therefore, this increased running time cost the owners and crews around $650,000. This gives an idea of the cost involved in extending the activities of a fishing fleet to distant banks.

Cause of the decline.—The decline in the Georges Bank fishery to a large extent is due to the commercial fishery itself. During recent years the fishing fleet has removed tremendous numbers of haddock from the banks. This heavy catch was bound to affect the fishery unless the haddock population were absolutely unlimited in numbers. Recent developments have demonstrated clearly that this is not the case. The fish on Georges Bank are definitely limited in numbers and always have been in spite of the apparently endless abundance

found there is earlier years. This is just as true for the haddock on Georges as it was for the great herds of buffalo on the western plains. These buffalo once were found in such tremendous herds that for a long time it was believed that the numbers killed by man could not affect their abundance. Yet, the herds were almost exterminated when subjected to extensive and destructive killing by man. Like the buffalo herds, the haddock shoals are subject to rapid depletion if their enemy, man, finds it possible to kill off a sufficiently large number each year. And that is what happened during the last decade when the Georges fishery was at its peak. The catch of marketable haddock during the years 1925–31 reached an amazing total. In these years the combined New England otter-trawl and line-trawl fleet landed a total of more than 1,000,000,000 pounds of haddock from Georges Bank alone. This is equal to about 100,000 pounds from each square mile of the fishing ground.

In addition to the tremendous catch of marketable fish, the otter trawlers destroyed unnumbered millions of baby haddock too small for market. Unfortunately, we have no complete records of the extent of this destruction of small fish. However, there are records for two periods, 1913–14 and 1930–31. During the first period extensive observations made by Bureau of Fisheries observers engaged in the trawler investigation showed that between two-fifths and four-fifths of the total number of haddock caught by the otter trawlers were below commercial size. At that time, this destruction was not alarming, as the otter-trawl fleet was small. The total number of marketable haddock which they caught and landed in 1914 was about 4,700,000 fish while the baby haddock destroyed in a year's fishing amounted to about 10,000,000 fish. In later years, with the growth of the otter-trawl fishery, the capture of both marketable haddock and baby haddock increased. During the study of the haddock fishery in 1930 and 1931, great numbers of measurements were taken by observers on 20 sea trips aboard commercial trawlers. These records show that between September 1930 and May 1931 about half of the haddock taken in South Channel and about two-thirds of those taken on Georges Bank were below marketable size. Thus, in the course of one year trawlers fishing out of Boston, Gloucester, Portland, Groton, and New York destroyed about 63,000,000 baby haddock. This is about equal to the number of haddock in a commercial catch of 200,000,000 pounds. No extensive records are available for other years, but our observations show that the number destroyed usually is not so great as in 1931. Every brood of young fish, however, is subject to this extensive destruction during its early years before it reaches marketable size (fig. 7).

If the number of haddock killed by the commercial fishery is greater than the average number produced each year by spawning and growth, then the haddock population declines progressively from year to year and fishing each year becomes poorer. This has been happening on Georges Bank for the past 10 years, although at a somewhat irregular rate due to differences from one year to another in the success of the spawning seasons and changes in the fishery. Thus, in 1928, 1929, and 1930, the catch-per-day's fishing declined rapidly due to a decreasing abundance of haddock. In

1931 the decline was less rapid due to improvements in gear. There was a slight improvement in the commercial fishery in 1932 due to a good spawning season 3 years earlier, for young haddock spawned in 1929 reached scrod size in 1932. In 1934 the catch per day was fairly well maintained, partly due to a fair spawning season in 1931, but even more to the fact that a large part of the fleet was fishing on Sable Island, Emerald, and Quereau, and the strain on the Georges population thus was reduced to less than one-third that of previous years. But for the 10-year period the general trend has been rapidly downward (fig. 8).

Future of Georges Bank.—The future of the Georges Bank region is of vital concern to New England fishermen and marketmen; in fact, to the entire New England fishing industry that depends on the

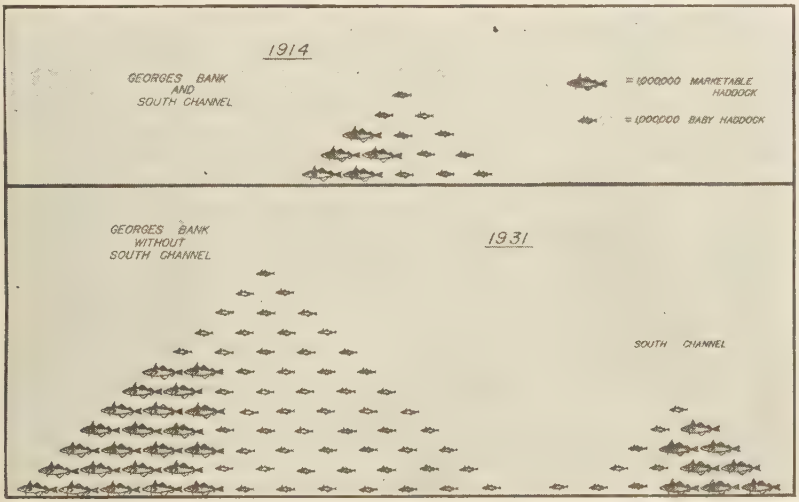

FIGURE 7.—Showing approximate number of marketable and baby haddock caught by otter trawlers on Georges Bank in 1914 and 1931. Each fish in the diagram represents 1,000,000 in the actual catch.

success of the offshore fishing fleet. Can we expect that in future years these fertile fishing grounds will improve and once again furnish plentiful catches such as were taken there in past years? Can we expect Georges to show little or no improvement but to continue furnishing catches at the present relatively low level? Or can we expect that the decline that has taken place during the past 10 years will continue until fish on Georges are so scarce that the daily catches are but a fraction of those taken at present? If the latter occurs, it will mark the end of Georges Bank as a great fishing ground. Our boats will be forced to seek fish farther and farther from their home port. Production costs will continue to increase due to increased time and fuel expended running from port to fishing bank and back. As the distance from port becomes greater, it will become ever more difficult and costly to keep the catch in good condition until landed.

To the above questions, past experience can justify but one answer. Under the present fishery, which increases in intensity with each

new boat that is built, the decline on Georges Bank will continue. Our best example of the results of such a fishery is the North Sea where an intensive and destructive fishery similar to our own has been pursued over a much longer period of time. During the years 1929–32, British first-class steam trawlers (averaging 241 gross tons) fishing the North Sea averaged 550 pounds of haddock and 1,830 pounds of all marketable fish per 15-hour *actual towing time*. During the same years large New England trawlers (averaging 259 gross tons) fishing Georges Bank averaged 10,400 pounds of haddock and 14,500 pounds of all marketable fish for approximately the same fishing time. Thus, haddock catches in the North Sea averaged about one-twentieth as great as on Georges Bank while catches of all marketable fish averaged about one-eighth as great. The North

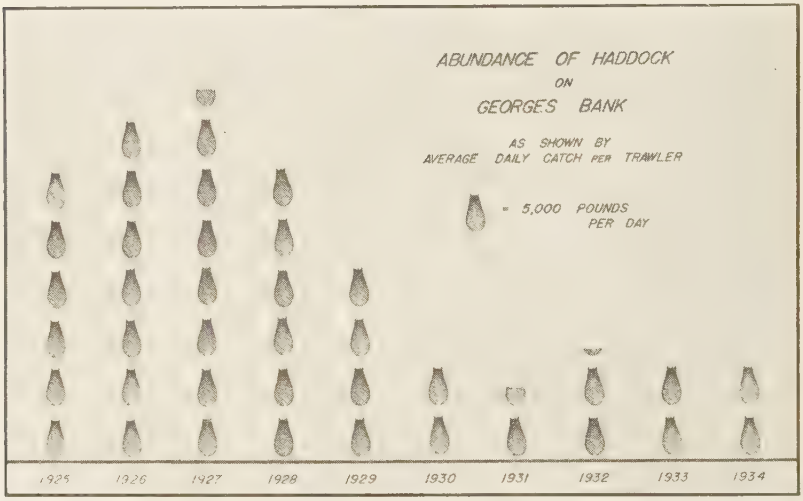

FIGURE 8.—Changes in the abundance of haddock on Georges Bank during the last 10 years, as shown by the average daily catches of large otter trawlers. The averages for the years 1925–30 have been adjusted to the present base for Vigneron-Dahl trawling gear.

Sea marketable catch included haddock down to one-half pound each and some dogfish, goosefish, skates, and rays. The years 1929–32 were considered poor years on Georges Bank (fig. 9).

There can be no doubt that with fish as scarce as in the North Sea, Georges Bank could support no major fishery. With such low catches our fishermen would have to receive more than 15 to 20 cents a pound for their haddock even to pay expenses. Every fish dealer in New England has a fair idea of how much haddock he could sell at a profit if he had to pay the fisherman more than 15 cents a pound.

The usual answer to this situation is a shift of the fishing fleet to new grounds. Such a development already has begun with the shift of our large trawlers to the Nova Scotian Banks. This does furnish temporary relief to the nearer banks, but as the distant banks in turn show signs of depletion the situation again becomes serious. From the Nova Scotian Banks we may go to the Grand Bank for cod and at times for catches of haddock. But with each

step away from our home ports, the production costs increase as well as the difficulties in preserving the catch. Furthermore, we get into direct competition with the fishing fleets of the various European countries and it would seem that with their lower production costs

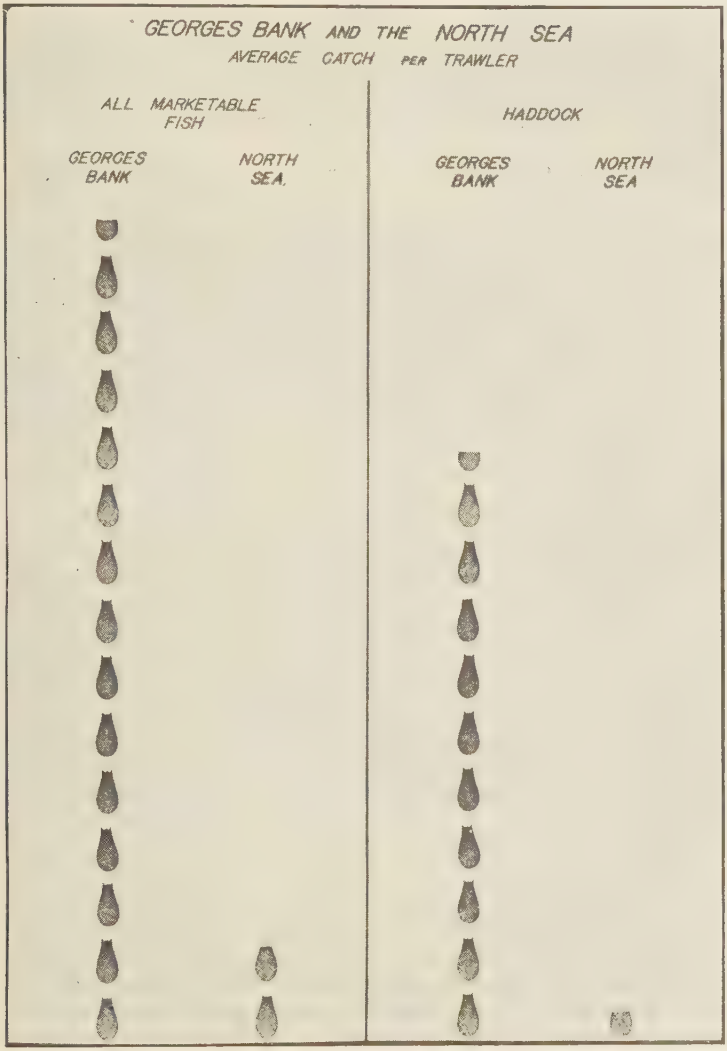

FIGURE 9.—Otter trawl catches on Georges Bank and in the North Sea compared. The chart shows the daily catch per trawler averaged for the 4 years 1929–32, inclusive. Each cod end represents 1,000 pound in the actual catch.

and living standards, they can outfish us on banks so far from our home ports. Furthermore, as long as we have the great Western plains where beef cattle can be raised cheaply, it is unreasonable to expect the price of fish to respond fully to increasing scarcity. If the cost of fish increases faster than the cost of meat, the market for fish will decrease. If our fisheries are to survive as major

industries, the production costs of raw materials, i. e., fish, must remain reasonably low.

REMEDIAL MEASURES

Examined through the eyes of past experience, the future of the fisheries as a major industry does not appear too promising. But during recent years there has been developing an accumulation of knowledge concerning the biology and economics of our commercial fisheries which, if intelligently used, can alter the whole future of the industry.

The fishing industry can be compared in many ways with the meat industry. Our fishing banks are like a great area of grazing land stocked with herds of cattle. Methods used for catching fish might be likened to the methods used in rounding up the market herds of cattle.

A short-sighted rancher thinking only of this year's market might send out his cowboys to round up as many head of stock as possible, including grown cattle, yearlings, and calves. Everything in the roundup would be killed, the grown animals to be shipped to market and the calves to be left to rot or to be eaten by the vultures and coyotes. If the number thus killed each year were great, we should expect the rancher's herds soon to dwindle in size until the annual roundup yielded very little beef. And great stretches of pasture land would go to waste for lack of sufficient animals to graze it.

The modern rancher operates in no such wasteful fashion. Each year he kills off only the grown stock and leaves the rapidly growing calves until they are of greatest value. And he knows that in the long run he will get the greatest amount of market beef by keeping his herds of sufficient size to utilize all of the grazing land available. It is true that the wolves will get some of the young stock left on the range and some will die from other causes, but the remainder will increase many times in size and value and will repay the rancher for the additional time they were left on the range. And the young calves that formerly were killed and left to rot will be a total gain for if left alone another year or two they would double and triple in size and thus form a valuable addition to the annual market herds.

Our fishing methods now are like the methods of the wasteful rancher. Each year by means of otter trawls, line trawls, and hand lines we have been killing off great numbers of haddock of all sizes, the large fish to be brought into port and marketed, the small fish to be shoveled overboard dead, a total loss to the fishery. In this way haddock have been removed much more rapidly than they have been replaced by spawning and growth; consequently the shoals of fish on Georges Bank have declined in numbers until they are far too few to utilize fully the rich supply of food available on the bank. With this, the abundance of haddock and the total catch has rapidly declined.

There can be no question but that some change must be made in our methods if we wish fishing on Georges Bank to be consistently better. We must find some way to put more young fish on the banks. But these fish will be subject to the same losses through early capture and destruction that are suffered by the present population o

young haddock.) Or we must find a way to make better use of the fish now supplied to the banks by natural spawning and growth.

An increase in the number of young fish produced on the bank each year would help the commercial fishery; but it would be a stupendous undertaking to handle sufficient eggs by artificial propagation (hatcheries) to affect appreciably a fishing area as large as Georges Bank. In 1932 approximately 100,000,000 pounds of haddock were landed from Georges Bank. This catch was made up of about 40,000,000 fish. Let us assume that this is equal to one-third of the number of marketable size haddock on the bank at the beginning of the year (during the spawning season); then the total population of haddock exceeding the minimum commercial size of

FIGURE 10.—Biologist obtaining haddock length measurements and scale samples to be used in the study of distribution, growth rates, migrations, etc.

1½ pounds numbered around 120,000,000 fish, about half of which were females. The average number of eggs spawned by each female would be around 300,000. Therefore, the total number of eggs spawned in 1932 on Georges Bank would be of the order of 18,000,000,000,000. In 1929, when haddock were more abundant, the Georges Bank catch was 220,000,000 pounds. By the same reasoning as above the total number of haddock eggs spawned in 1929 would be somewhere around 40,000,000,000,000. In either case the number was tremendous and it does not seem feasible to attempt to compete with nature in such an enormous hatching and rearing experiment.

If it is impractical or impossible to assist nature materially in producing young fish, then we must find ways to make better use of the fish now produced on the banks by natural spawning and growth. It is here that the fishing fleet can help its own future immensely if it will use fishing methods that do not harm the

young fish during their early years while they are growing rapidly and are of little value. The vital need is a practical method by which this can be accomplished without handicapping the present commercial fishery. If such a method can be found and is put into practice, it will save hundreds of millions of baby haddock to grow to marketable size and improve the fishermen's catches.

The extensive destruction of baby haddock described on page 1 is due mainly to the otter trawlers whose great nets sweep up all sizes of haddock that are over 6 to 10 inches in length. During

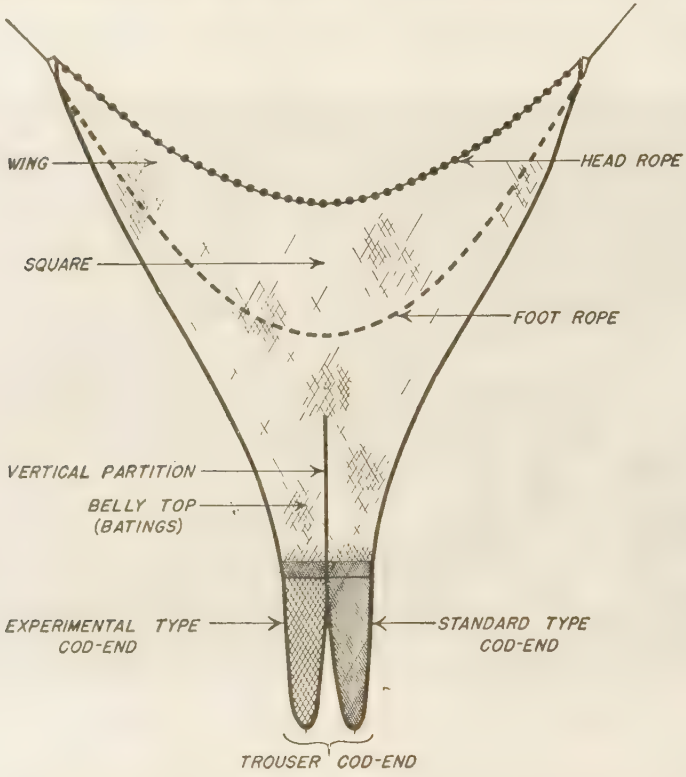

FIGURE 11.—Diagram of an otter trawl with a trouser cod-end for preliminary work with savings gear. A cod-end similar to the usual commercial type was used on one leg while the experimental gear was used on the other.

recent years much work has been done both in the United State and abroad to develop an efficient, practical method by which the destruction of baby haddock by otter trawlers can be reduced. In 1931 and 1932 the Bureau of Fisheries carried out a series of tests first using small cod ends, then a commercial trawl with trouser cod ends, and finally full-sized commercial trawls fished from trawlers during regular fishing trips. Most of the work was done on the steam trawler *Kingfisher* and dragger *Exeter*. Results of the work definitely proved that a large proportion of the baby haddock now destroyed by the otter trawlers would be saved by increasing the size of the mesh used in the commercial trawls (figs. 11 and 12).

Doubtless there are some fishermen who still will argue that it does no good to increase the size of mesh used in otter trawls. These men will maintain that the sides of the mesh pull together as soon as a strain is put on the netting; therefore, while the net is being towed, small fish cannot escape through big mesh any better than through small. This argument can be developed reasonably enough

FIGURE 12.—Hauling in the trouser cod-end used on Georges Bank in June 1931 to test the effect of different mesh sizes. The two legs of the cod-end can be seen trailing from the side of the boat. The nearer leg is of large mesh while the further one is a small mesh similar to the usual commercial cod-ends.

from the appearance of the cod end as it is hoisted over the rail full of fish. When suspended in the air in this way with a catch of several thousand pounds, the mesh in the cod end does pull together, especially up near the splitting strap where the netting is bunched. However, when the net is towing in the water the mesh opens up considerably. We have actually observed this by towing a net near the surface where it could be examined from a second boat. When the net was empty, the mesh did pull together, but a catch of any kind bulged out the rear end of the cod end and opened up the

meshes just forward of the catch. Numerous tests with commercial gear showed that *small haddock do escape through these opened mesh* for *small-meshed cod ends caught*, on the average, *about five times as many small haddock as cod ends with large mesh.* If these facts still leave the skeptical fisherman unconvinced of the effectiveness of large mesh, we can only recommend that he try these experiments himself (fig. 13).

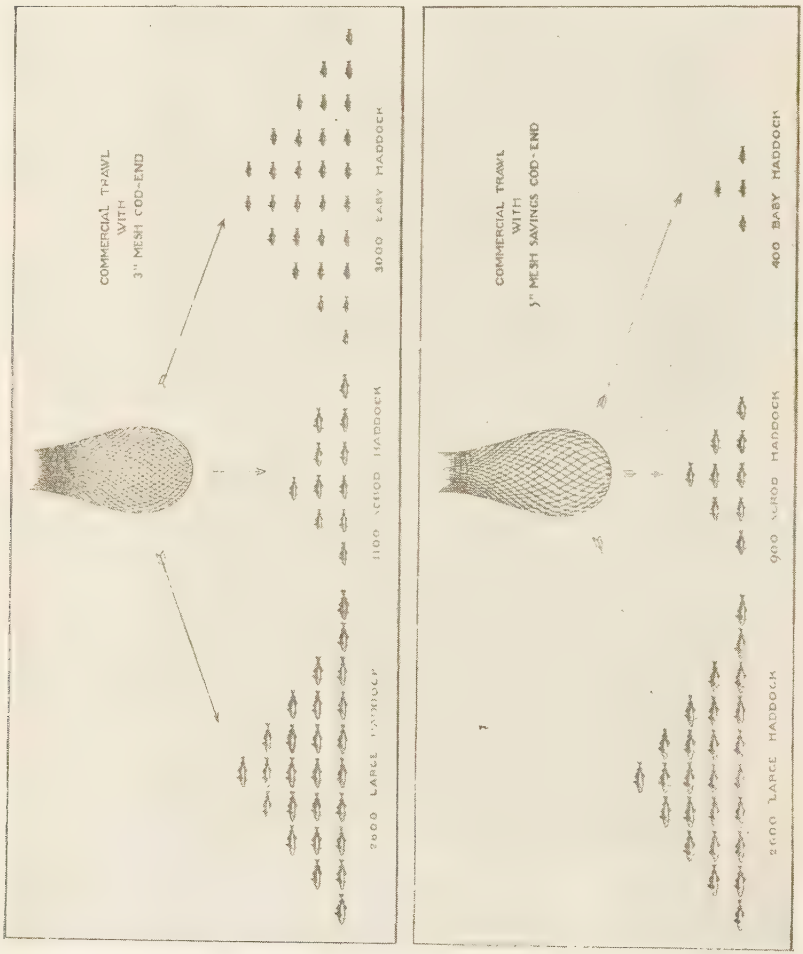

FIGURE 13.—Comparison of haddock catches obtained with commercial trawls using small-meshed and large-meshed cod-ends. Each fish in the picture represents 100 fish in the actual catch.

During the commercial fishing operations mentioned above, extensive tests were made which showed that a 4¾-inch mesh used in the cod ends of commercial trawls would catch, on an average, but one-fifth as many baby haddock, approximately equal numbers of scrod haddock, and as many or more large haddock as the usual commercial cod end of 3-inch mesh. In fact, extensive trials made by F. M. Davis on English trawlers have shown that large-meshed nets actually catch more large haddock than small-meshed nets, probably due to the better draft of water through the larger mesh. In

the Bureau tests, large mesh offered no difficulties in handling and caused less trouble from gilled fish than small mesh. Although the large mesh usually gilled somewhat more fish of medium size, this was more than offset when small fish such as baby haddock, small dogfish, or herring were present, and the large mesh was much cleaner than the small (fig. 14). The large mesh also caught less small trash which decreased the work involved in handling the catch.

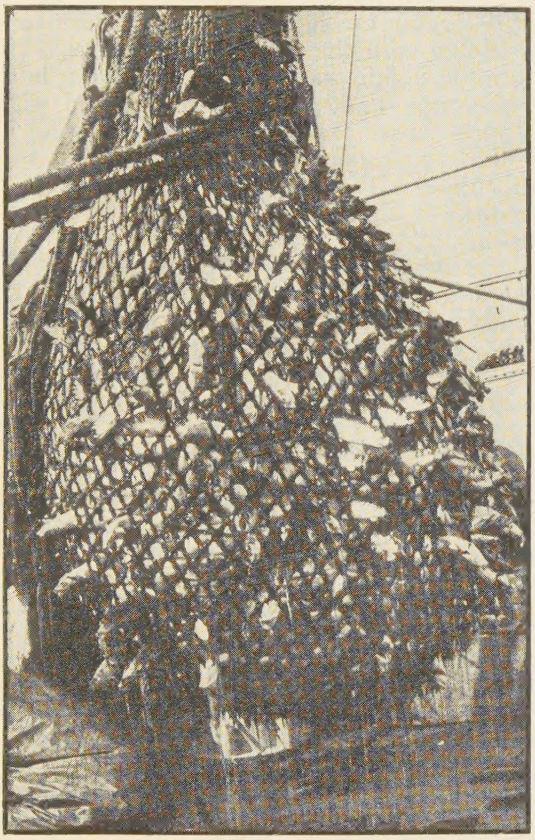

FIGURE 14.—If the cod-end had been made of large mesh most of these herring would escape, thus saving the fishermen of the *Illinois* the job of hoisting them on deck and shoveling them overboard.

It towed more easily, for less resistance was offered to the water, and it was just as rugged as small mesh when the proper size of twine was used.

OTHER METHODS FOR SAVING BABY HADDOCK

There are various other methods which might be used to protect baby haddock. These include closed seasons, closed areas, and a minimum market size.

The destruction of baby haddock is not limited to any particular ground or season. Consequently, closed seasons and closed areas

would be of limited effectiveness. Furthermore, such measures would restrict considerably the activities of the trawling fleet; therefore they do not appear advisable unless no other effective method of protecting young fish can be found.

The third method mentioned above, a minimum market size, would be of some value for it would remove the incentive for trawlers to concentrate their fishing activities in areas where baby scrod (1- to 1½-pound haddock) predominate. As long as there is even a limited market for such fish, some fishermen will continue to fill up their boats with these sizes. The capture and marketing of such fish is an economic waste for if they were left on the bank another year, they would become good-sized scrod while in 2 years they would become "large" haddock. The marketing of baby scrod also is an injustice to fishermen who conform to the usually accepted market cull, for the landing of considerable quantities of these fish is bound to affect the general price level for the better grades of haddock.

However, a minimum market size alone will not be adequate to reduce greatly the destruction of baby haddock; but if this measure were used in conjunction with a minimum mesh size, it would make the latter much more effective. Shortsighted individuals would be discouraged from the illegal use of small mesh if no market could be found for the baby scrod which the small mesh would catch.

CONCLUSIONS

New England has been blessed with extensive and fertile fishing banks lying close to her shores. In past years these banks have supported great shoals of fish awaiting only to be gathered in by the hooks and nets of the fisherman. Georges Bank has formed an able New England substitute for the widespread grazing land of the West. It has furnished billions of pounds of low-priced food for New England's tables and New England's markets. If used intelligently, this tremendous natural resource will continue to support a great industry but if destructive exploitation continues, the fisheries will be reduced to a minor role for increased costs and reduced returns will make it impossible for fish to compete in the markets on a large scale with other foods.

In the North Sea fishery the problem is more complex than in our own, for the fishing fleets of several countries are involved. Nevertheless, recently there has been established a number of protective regulations. In 1933 the British Government enacted three measures for the assistance of the fishing industry. The first establishes minimum sizes of fish allowed to be sold; the second establishes closed fishing areas; and the third establishes minimum sizes of mesh for fishing nets.

Are we going to profit by the example of the North Sea and immediately establish regulations to check the continued destructive exploitation of our fishing grounds? Or will we wait until the fish on our banks are reduced to the same scarcity as in the North Sea where our trawlers would have to fish *15 to 20 days* to catch as much haddock as they now average in *1 day* on Georges Bank?

Corrective measures can be readily devised. They should include a minimum mesh size for use in the otter trawls and a minimum

market size for fish that can be landed. A minimum market size of 1½ pounds gutted is recommended for haddock; this agrees with the present New England Fish Exchange cull list. A minimum mesh size of 4¾ inches is recommended for otter trawls. Extensive trials have shown that this mesh will hold practically all haddock weighing 1½ pounds and over, and release an average of four-fifths of the haddock below this size (fig. 15). If these regulations had been in effect in 1931, they would have protected the Georges Bank haddock population about as much as would have been accomplished by tying up the entire fishing fleet for 6 to 7 months of that year.

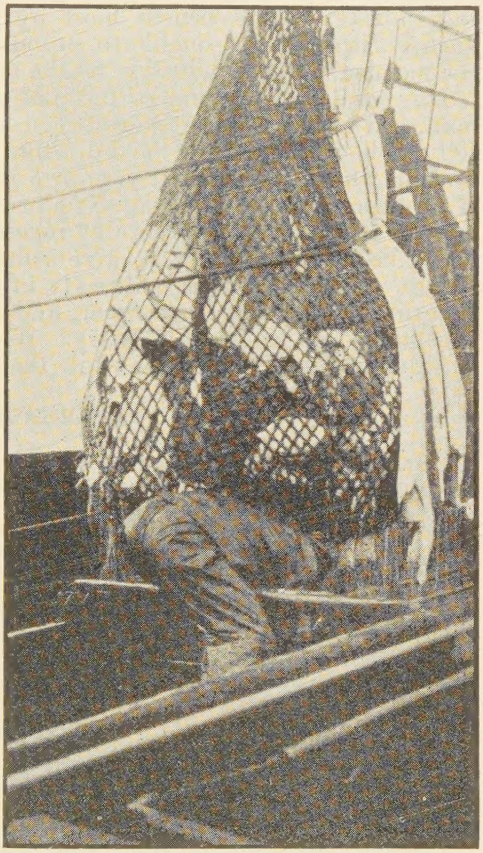

FIGURE 15.—A savings cod-end showing one method of using large mesh. The belly of the cod-end and the rear end of the top are made of small mesh while the remainder is of large mesh.

It is not claimed that these regulations will return the catches on Georges Bank to what they were during their heyday in 1926–28. However, they will cause millions of baby haddock to be left on the banks to become scrod and large haddock instead of rotting bodies to be devoured by sea gulls and other scavengers. Due to variations in natural conditions, fishing will be poorer in some years than in others, but on the whole it will be much better than will be possible if present methods continue.

During the past 3 years the Bureau of Fisheries has recommended repeatedly that the operators establish a minimum mesh size for use in the otter trawls but no concerted action has resulted from these recommendations.[4] Experience indicates that to get effective, coordinated, and continued action we must have definite regulations such as have been put in force in England and some other European countries. To be of most benefit to our fishery these regulations also must be applied to trawlers of other nationalities which frequent the fishing banks exploited by our fishing fleet. This will require the cooperation especially of the United States and

[4] The individual efforts and cooperation of a number of operators and captains must be recognized. However, these men have as yet received no extensive cooperation from the remainder of the industry.

Canada, the two countries chiefly interested in the New England and Nova Scotian banks.

The International Council on Fishery Investigations recently has recommended the drafting of an international treaty to require the use of nets with larger mesh. Here is a definite proposal designed to improve the fishery without tying up the fishing fleet for several months each year or closing certain banks to all fishing for long periods of time. In the United States the New England fishing industry would benefit most by the proposed treaty. Consequently, it seems reasonable to suppose that it is to the interest of the members of this industry to take action in the matter.

It is not difficult to understand that the average fisherman, marketman, and owner is more interested in how much fish he will catch or sell and how much money he will make tomorrow and next week than he is in what happens next year or 5 years from now. Nevertheless, if he expects to remain employed profitably next year and 5 years later or to have money profitably invested in the industry in years to come, he must find time to give some thought and interest to the future. And the future is directly in the hands of every fisherman, captain, marketman, boat owner, and other individual interested in this great New England industry. Will they think about it and act, or think about it and forget while their catches continue to decline?

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U. S. GOVERNMENT PRINTING OFFICE: 1936

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